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ABSTRACT

This study examined the effects of different types of cooperative learning environments on low, average, and high ability students' perceptions of the middle school science classroom environment. Subjects were 15 teachers and 1,185 students from the sixth-, seventh-, and eighth-grades of two middle schools. Data were gathered from a variety of sources: (1) a student pretest and posttest using the My Class Inventory measure; (2) classroom teacher reports; (3) informal interviews with teachers; and (4) classroom observations. Students in the no cooperative learning environments perceived the science classroom as more cohesive than students in the average and high cooperative learning environments. Students in the average cooperative learning classes perceived themselves as less competitive than those in the no and high cooperative learning classes. No significant interaction effects were found between the type of cooperative learning environment and ability level. The results suggest that the quality of cooperative learning is a major determiner in how students perceive the science classroom. (A copy of the cooperative learning assessment instrument completed by teachers is provided. Contains 86 references.) (MDM)

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The Effects of Cooperative Learning on Different Ability Level Students' Perceptions of the Middle School Classroom Environment

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ABSTRACT

The Effects of Cooperative Learning on Different Ability Level Students' Perceptions of the Science Classroom Environment

The purpose of this study was to determine the effects of different types of cooperative learning environments on low, average, and high ability students' perceptions of the middle school science classroom environment. To analyze the impact of these effects, students in no cooperative learning environments, average cooperative learning environments, and high cooperative learning environments were compared to one another on five measures of perceptions: cohesiveness, satisfaction, friction, competitiveness, and difficulty.

Fifteen teachers and 1185 students participated in the study which was conducted in the sixth, seventh, and eighth grades of two middle schools. Several types of data were collected: pretest and posttest data, descriptive data gathered from a questionnaire completed by the classroom teachers to assess the quality and quantity of cooperative learning, informal interviews with teachers, and classroom observation data.

Using the My Class Inventory (MCI), all participants of the study were administered a pretest and posttest. A 3 x 3 Factorial Multivariate Analysis of Covariance was use to statistically analyze the data. The classroom was used as the unit of analysis. The perception dimensions on the pretest were used as the covariates, and posttest perception dimensions as the dependent variables. A Tukey post hoc procedure was employed to determine which groups were significantly different from each other. The results indicated the dimensions of cohesiveness and competitiveness were significant for the main effect of type of cooperative learning environment. Students in the no cooperative learning environments perceived the science classroom as more cohesive than the students in the average and high cooperative learning environments. There was no significant difference between the high cooperative and average cooperative learning environments on this dimension. On the dimension of competitiveness, the average cooperative learning classes perceived themselves as less competitive than the no and high cooperative learning classes. There was no difference between the no cooperative learning classes and the high cooperative learning classes.

Cohesiveness with ability level was significant where low ability students perceive the science classroom as more cohesive than their average ability peers, and high ability students perceive their science learning environment as the least cohesive of the three ability levels.

No significant interaction effects were found between the type of cooperative learning environment and ability level. The dimensions of satisfaction, friction, and difficulty were not significant. The qualitative data were used to aid in the interpretation of the statistical results. The implications and recommendations for science educators, teacher educators and researchers are given.

Introduction

In our society science plays an important role in every citizen's life. Determining whether we recycle products, plant a garden, vote for a certain candidate, or understand what we read in the newspaper or hear in the news are based on a general understanding of the nature and processes of science. People who do not grasp science concepts may make unwise decisions, or worse yet, make no decisions concerning issues that may affect them and others.

The scientific literacy of the youth of America is decreasing. In 1986 the National Assessment of Educational Progress found the average performance of 17 year olds in math and science remained substantially lower than it had been in 1969 (AAAS, 1989). The Science Report Card (1988) survey showed that less than half of the seventh graders and even fewer eleventh graders perceived that science would be important to them in the future or could help them earn a living. In their analysis of national data, Yager and Yager (1985) indicated that school science failed to affect student perceptions positively. The data also showed that students perceive science becoming less fun and exciting the longer they stay in school; teachers are viewed as providers of information; students do not feel more successful or curious as they progress through a science program; and science programs do not provide accurate, encouraging information concerning science careers. As a nation, we have seen enrollments in college science programs drop steadily. Our students' achievement scores on math and science tests rank near the bottom of the list for industrialized nations.

Many young Americans leave school with inadequate knowledge concerning science, math, and technology (Education Commission of the States Task Force on Education for Economic Growth, 1983). Whether one plans to enter a science related career or not, science education is vital to all individuals. Some of our students will be the future scientists, but all students will benefit from science skills which will help them make responsible decisions for improving the quality of their lives, other peoples' lives, and the earth itself. Rapid change is a facet of our culture and it is essential that people have a basic understanding of the world of science in order to cope with these changes.

How can these science education problems be remedied? The general recommendations made by Project 2061:Science for All Americans are an integrated curriculum, stressing overall themes versus rote memorization of terms, having students model how scientists work, and engaging students actively (AAAS, 1989).

One of the outcomes of the science reform movement is the development of new science curricula. A major contributor of new methods and curricula is Biological Sciences Curriculum Studies (BSCS). BSCS developed a middle school science program called Science and Technology: Investigating Human Dimensions which is in its last stages of being field tested in various places across the nation. This middle school project has incorporated research based knowledge and the recommendations of the various educational

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organizations and policy makers (AAAS, 1989; BSCS, 1988; California State Department of Education, 1989; Carnegie Council, 1989; NCATE, 1987; NMSA, 1982: NSTA, 1990). The focus of this study was to analyze the recommended cooperative learning strategy and its effects on different ability students' perceptions of the middle school science classroom.

Background of the Problem

Research indicates that the perceptions of classroom environments influence student achievement, self esteem, motivation, and social interactions (Haertel, Walberg, & Haertel, 1981). Because students spend up to 15,000 hours at school by the time they finish high school (Rutter, Maughan, Mortimore, Ouston, & Smith, 1979), students certainly have reactions to and perceptions of their school experiences. If classroom environment can be altered to improve motivation, attitudes towards a subject, and achievement, then educators must take notice of the classroom environment as a major influence on students.

Cooperative learning creates a particular classroom environment. How the quality and quantity of cooperative learning affects student perceptions of the science classroom environment is one aspect of this study. Research indicates that cooperative learning has many positive outcomes such as increased motivation (Slavin, 1978, 1980; Ziegler, 1981), higher achievement (Slavin, 1990), increased general self esteem (Madden & Slavin, 1983; Blaney, et al, 1977; Lazarowitz, et al, 1982), positive attitudes towards the class and subject (DeVries, et al, 1974; Edwards & DeVries, 1972, Johnson, et al, 1976), and improved social skills (Sharan et al., 1984; Bridgeman, 1977; Johnson, et al, 1976). The emphasis of these studies have been achievement and attitudes, not perceptions of the cooperative learning science classroom environment.

The other component of this study was how cooperative learning affects different ability level students' perceptions of their science classroom environment. Are the perceptions of different ability students in cooperative learning environments equal? Students of different abilities have different experiences in the classroom. In a traditional school setting, there are winners and losers. The lower ability students usually experience much failure and therefore develop a low self esteem. They often compensate for this low self esteem by developing anti-social or delinquent behavior (Schafer & Olexa, 1971). On the other end of the spectrum, the high ability students are often considered "eggheads" or "nerds" by their peers and may be ostracized due to their academic orientation (Johnson, et.al., 1984). Learning how the cooperative learning component of the science classroom environment influences the perceptions of different ability-level students will provide valuable information which educators can use to better address the needs of these students.

Perceptions of the classroom environment contribute considerably to the many facets of a student's education. To ignore the importance of these perceptions would do a great disservice to our students. Learning the extent to which cooperative learning and student ability level affects perceptions of the science classroom environment may provide insight to how these components influence achievement, motivation, and interpersonal skills. In Lawrenz's (1976) research, perceptions of the classroom environment can

predict 29-39% of the variance in biology, chemistry, and physics students' attitudes towards science. In an analysis of eleven studies, student perception of the social environment accounted for a median of 30% of the variance in cognitive, affective, and behavioral postcourse measures (Anderson & Walberg, 1974). These results suggest consistency across different school subjects and different languages and cultures (Anderson & Walberg, 1974). Researchers have examined the effects of cooperative learning on achievement and attitude outcomes, but they have not studied different ability level students' perceptions of the science classroom environment or the impact of different qualities or quantities of cooperative learning.

Theoretical Background

The theoretical framework for this study is grounded in Kurt Lewin's psychological field theory and the work of his followers. Lewin (1936) formulated in his theory of topological psychology that there is a relationship between the person's needs and the environment. This interaction between needs and the environment determines the behavior of the individual. When a person is in a particular environment, that environment creates certain situations which make some behaviors possible and others not possible.

Further work by Murray (1938), Pace and Stern (1958), and Getzel and Thelen (1960) support the notion that environment and a person's needs influences behavior. Specifically, Pace and Stern (1958) helped establish research in the perception area in their study of the characteristics of college environments to identify the environmental components which could be related to the personal needs of students. Operationally, Pace and Stern define press as the "characteristic demands or features as perceived by those who live in the particular environment" (p.270). This research demonstrated that one can analyze the perception of environmental press within a complex institution.

Getzels and Thelen's (1960) model for the class as a social system supports their predecessors' findings and theory. Their model states that in school classes, personality needs, role expectations, and classroom climate interact to predict group behavior including learning outcomes.

Obtaining this type of information can be useful in science education. The effects that cooperative learning has on the perceptions of the science classroom environment can help determine if it is one that best meets the needs of our students. This type of practical information could help schools and teachers in the decision making process concerning the type of environment that would most benefit their particular students.

REVIEW OF RELEVANT LITERATURE

Environmental Perception Research

The research conducted in the area of perceptions has been influenced by the theory and studies of Lewin (1936), Murray (1938), Stern and Pace (1958), Walberg, Haertel, Anderson, and Fraser. The classroom environment research has traditionally investigated the associations between students' affective and

cognitive outcomes and their perceptions of the psychosocial environment of the classroom (Haertel, Walberg & Haertel, 1981). This study investigated how the cooperative learning environment affects student perceptions of the middle school science class. Evidence from schools in different cultures supports the idea that a student's positive perception of the classroom environment is related to cognitive, attitudinal, and behavioral outcomes (Fraser, 1981, Haertel, Walberg, & Haertel, 1979; Walberg, 1976). Peer influences are a strong and consistent determinant of a wide range of educational outcomes such as achievement scores, course grades, academic self-efficacy, and occupational aspirations. (Schunk & Hanson, 1985).

Well-developed personal relationships among students are very important according to Haertel, Walberg, and Haertel (1981) who labeled this situation "cohesiveness". How students interact in the classroom can affect the student perceptions of the learning environment was the focus of a study conducted by Tobin and Gallagher (1986). Their findings in the science classroom indicated that students who normally participate a great deal in the class perceive more involvement and rule clarity which refers to rules being applied differently to different students. In fact, Tobin and Gallagher recommend that small groups be used to facilitate equal perceptions.

Owens & Barnes (1982) investigated the individualized, cooperative, and competitive learning climates and found a relationship between learning preferences and students' perceptions of the classroom environment. They found that personal and cooperative learning preferences are related to perceptions of actual classroom emphasis on interpersonal relationships and personal development.

In the research that has been conducted on perceptions of the actual environment compared with those of the preferred environment, it is evident that there are certain aspects in the classroom environment that are preferred by elementary and middle school students. They include more cohesiveness, affiliation, and less competitiveness (Fisher & Fraser, 1983;Fraser, 1984; Moos, 1979). These components are similar to what Johnson, Maruyama, Johnson, Nelson, and Skon (1981) and Haertel, Walberg, and Haertel (1981) found to be contributing factors in classrooms in helping or hindering achievement.

In Spector and Gibson's (1991) qualitative study, they analyzed middle school students' perceptions of what factors aided in their learning of science. Some of those factors which involved high ability students which can be related to this study are interaction with peers and adults, trusting the individuals in the classroom environment, experiencing a sense of self-reliance and being active learners. The foundation of cooperative learning is based on these factors also. In order for cooperative learning to be successful, interdependence and interaction are required (Johnson & Johnson, 1985).

Predicting student outcomes from student perceptions of the classroom environment in a study of eighth and ninth grade science classrooms by Fraser & Fisher (1982) supported the previous extensive research of a strong relationship between learning outcomes and student perceptions of the classroom environment. Based on their study, Fraser & Fisher suggest that attitudes toward aspects of science social issues and leisure interest in science can be promoted in classes with environments that encourage greater

participation, order, organization, and innovation.

A study conducted by Wang and Walberg (1986) indicated that various types of instructional models do influence students' perceptions of the classroom. The MCI instrument was used and showed that classrooms which students rated highest in Competitiveness and Friction and lower in Cohesiveness and Satisfaction featured the greatest use of individualized prescriptions, task flexibility, student choice, diagnostic testing, and peer tutoring. The authors state that these exploratory findings may suggest that programs like peer tutoring which might be expected to promote cooperation and reduce friction, could actually increase students' sensitivity to differences in ability and their perceptions of competitiveness.

Studies specifically designed to analyze the direct influence of cooperative learning and student perceptions of the learning environment are limited. In a study of elementary age children, conducted by Talmage, Pascarella, and Ford (1984), their results indicated that the length a teacher uses cooperative learning strategies is significantly associated with reading achievement and students perceptions of the degree of cooperation in their classroom environment.

Costello (1987) investigated the differences in the learning environment perceptions of students in different ability-grouped English and math classes. The study indicated that students of different abilities had different perceptions of the classroom environment and the perception was related to student achievement. Overall, Costello found that higher ability tracks of math and English perceive the classroom climate more favorably than students in middle- and lower ability tracks. Positive correlations were also found between student achievement and classroom environment perception.

COOPERATIVE LEARNING REVIEW

How does the quality and quantity of cooperative learning affect students' perceptions of the science classroom environment? Does cooperative learning in science classroom situations affect different ability students' perceptions of the classroom environment differently? The cooperative learning model used in this study as described by Johnson and Johnson (1989) include the components of positive interdependence, face-to-face interaction, individual accountability, interpersonal and small group skills. These elements need to be carefully structured in order for cooperative learning groups to be productive. Ideally a productive cooperative group would increase student achievement, enhance social skills, and build self esteem as Slavin (1990) showed in his research.

Owens and Barnes's (1982) study broadly supports research in cooperative learning (Johnson & Ahlgren, 1976; Johnson, Johnson, & Anderson, 1978). The researchers showed that cooperative attitudes are positively correlated with a high regard for intrinsic motivation, open expression of ideas and feeling, and high self esteem. Individualistic attitudes are negatively related to open expression of ideas and feelings and to self-esteem.

Studies have shown that if cooperation fails, the benefits of the group process breaks down. The

free rider effect as described by Kerr and Bruun (1983) is letting one or two members of the group do the task while the less able members give less effort. Another pitfall when cooperation breaks down is when the high ability group member does the majority of explanation of what is to be learned called the rich get richer effect (Hill, 1982; Lamm & Trommsdorff, 1973).

Other behaviors which break down the group performance are destructive conflict (Collins, 1970; Johnson & Johnson, 1979), group resistance of the task (Salomon, 1981), unequal divisions of labor (Sheingold, Hawkins, & Char, 1984), too much dependence on authority (Webb, Ender, & Lewis, 1986), group helplessness (Langer & Benevento, 1978) and spending too much time socializing and not enough time on the tasks at hand (Latane, Williams, & Harkins, 1979).

Middle school appears to be the last opportunity to interest and motivate students in science. For middle school students, the cooperative learning strategy provides opportunities to work with their peers in a non-threatening, noncompetitive situation. At a time when peer interaction is vital to self esteem and well being, cooperative learning is a strong mode of learning. Peer relationships are a critical element in the development and socialization of the middle school student (Hartup, Glazer, & Charleworth, 1976).

Ability Research

Students are very aware of how their own academic ability compares to their classmates. A study by Stipek (1981) suggested that children may be able to assess the ability of their peers before they can assess their own performance! Depending on how the classroom is structured, the capacity to which children can assess their own and their peers' abilities is facilitated or impaired (Rosenholtz & Wilson, 1980). Rosenholtz and Simpson (1984) defined two types of classrooms which are related to ability level and indirectly to cooperative learning: multidimensional and unidimensional. The unidimensional classroom has four characteristics which include undifferentiated academic task structures, low student autonomy, students grouped according to ability level or work as a whole class, and formal performance evaluations. This type of classroom allows students to assess one another's ability level easily and sets up an environment of inequality. The classroom becomes a hierarchy where some students are successful and others are failures which leads to a strong perception of a student's own and their classmates ability levels.

Student perceptions of their own and their peers' academic ability levels will exert an influence over their social relations and attitudes toward school more in unidimensional classroom than a multidimensional one (Rosenholtz and Wilson, 1984). Further evidence for improved social status is provided in studies by Slavin (1977) and Slavin, DeVries, and Hulten (1975) who found that students in cooperative groups who gained in achievement also gained in their social status in the classroom, whereas in traditional classes such students lost status.

A multidimensional classroom environment is established in cooperative learning groups where students do a variety of tasks, there are different types of evaluation, there is high student autonomy, and students are heterogeneously grouped. The categorizing of students according to ability is deemphasized and

students do not readily compare themselves to one another (Rosenholtz & Wilson, 1984). Students will perceive each other as being more equal and the social power would be evenly distributed in cooperative learning groups.

In traditional classroom organization, the competitive grading and reward system creates peer norms that oppose academic efforts (Coleman, 1961). In this type of classroom, there are students who are winners and others who are losers. Due to the competitive organization, the success of one student decreases the chance the other students will succeed (Slavin , 1990). The student norms that are established in unidimensional classrooms tend to view high achievers as teachers' pets or nerds and high ability students may be ostracized or resented by their peers. In a multidimensional classroom, such as one that may be established through cooperative learning, intelligent students are viewed as an asset to a group. In this type setting these students are more likely to develop leadership, communication, and conflict management skills (Johnson, et. al., 1984).

On the other end of the spectrum, low ability students may feel like they are never successful in traditional, unidimensional classrooms. Being stigmatized as a low achiever may produce low expectations for the learner (Slavin, 1989). Low self esteem and negative attitudes toward school are fostered and opportunities to improve these factors are almost nil (Findlay & Bryan, 1970, Espositio, 1973; Rosenbaum, 1980). In the cooperative learning classroom, since the group is rewarded, the low ability students receive some type of positive feedback for academic achievement. Other studies indicate that there is considerable support for the positive effects on low ability students as members of heterogeneous groups (Esposito, 1973; Madden & Slavin, 1983).

In cooperative learning, heterogeneously grouping the students by ability level is recommended. The ideal group of four would have one high ability student, two average ability students, and one low ability student. This type of grouping encourages more elaborate thinking, more exchange of explanations, and more discussion seems to occur in heterogeneous groups (Johnson, et.al., 1984).

In a traditional, unidimensional classroom, only the academically oriented tend to contribute and are successful. In the heterogeneous group of cooperative learning, all students have the opportunity and responsibility to contribute. In terms of ability levels, cooperative learning groups gives the low ability students opportunities for success. They can share their ideas and become contributing member of a group. For high achievers, cooperative groups enable them to use critical thinking skills more readily. They tend to learn material better because they have to explain concepts to the other group members (Johnson & Johnson, 1991). The average ability students benefit from cooperative groups because they too share information.

Concluding from the research, it would suggest that cooperative learning should create a multidimensional classroom where different ability students' perceptions of the science classroom are enhanced.

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The research literature indicates that student behavior is related to the interactions of the student's needs and environment and how individuals' perceptions of their environment influence their behaviors. When incorporating a teaching strategy such as cooperative learning which according to research improves motivation, achievement, and self esteem, perceptions of a class should become more positive, The effect of quality and quantity of the cooperative learning and the ability of students will also influence student perceptions. The purpose of this study was to determine the effects of high, medium, and no cooperative learning environments on high, average, and low ability students' perceptions of the science classroom environment using the dimensions of cohesiveness, friction, competition, satisfaction and difficulty as the dependent variables.

Purpose of the Study

The purpose of this study is to examine the effects of high, average, and no cooperative learning environments on high, average, and low ability level students' perceptions of the science classroom environment. The perceptions of the environment were based on five components: friction, competitiveness, satisfaction, cohesiveness, and difficulty.

Research Hypotheses

The null hypotheses of this study were as follows:

1. There will be no significant differences between students' perceptions of the science classroom environment in the no cooperative learning environment, the average cooperative learning environment, or the high cooperative learning environment.
2. There will be no significant differences between low, average, and high ability groups' perceptions of the science classroom environment in different cooperative learning classrooms.
3. There will be no significant interactions between the ability level of the students and the type of cooperative learning environment.

Research Design

A variation of Campbell and Stanley's (1963) design #10, the "Nonequivalent Control Group Design" was used for this study. This design is appropriate for researchers who are working with intact groups, thus preventing random assignment.

The design is diagrammed below.

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O       X       O
-----------------------(no random assignment)
O               O
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In this study, there were three different groups of classrooms: high cooperative learning environments, average cooperative learning environments, and no cooperative learning environments. The amount and quality of cooperative learning to which the students were exposed was the treatment. In essence, the students who were involved in the high and medium cooperative learning classrooms were the treatment groups and the students who were involved in the no cooperative learning classrooms were the control groups. (See definitions of cooperative learning types on the next page). The independent and dependent variables are as follows:

INDEPENDENT VARIABLES:

HIGH COOPERATIVE LEARNING

AVERAGE COOPERATIVE LEARNING

NO COOPERATIVE LEARNING

HIGH ABILITY

AVERAGE ABILITY

LOW ABILITY

The quantity and quality of cooperative learning were determined by two methods. A questionnaire about cooperative learning techniques and how they are utilized in the classroom were given to the teachers and classroom observations were made by the researcher. The rationale for collecting both kinds of data was to determine if the teacher was using cooperative learning in the manner as stated in the questionnaire.

The measures which were used to determine the level of the cooperative learning environment were class time spent in groups, social skills, group arrangement, and group process skills/interdependence. Each one of these measures is defined below.

1. **Group arrangement** - refers to the physical environment of the classroom and/or arrangement and composition of the group.

2. **Social skills** - refers to the interpersonal skills that individual group members use to interact with one another.

3. **Group process skills/interdependence** - refers to the skills that the cooperative group uses. These skills are different from the social skills in that they are referring to group skills as a whole rather than individual skills within that group. Interdependence is a subset of group process skills. It refers to how the group members rely on one another and work together.

4. **Time spent in groups** - refers to the amount of time that the students are in cooperative learning groups

Based on the questionnaire and these observations the classrooms were classified according to the following manner:

<u>High Cooperative Learning Environment:</u>

a. The class meets at least three times a week in their cooperative groups and they spend at least 75% of the class period in these groups.
b. The groups consist of 2-4 students where the group arrangement allow everyone to

see and hear all other members of the group.

c. The students use group process skills such as reaching consensus, assigned roles, cooperate and share ideas, positive interactions, and are heterogeneously grouped.
d. Social group skills are promoted.
e. The teacher interacts with the groups and acts as a facilitator.
f. Interdependence among group members is common.
g. Activities are structured around the cooperative learning group.

Average Cooperative Learning Environment:

a. The class meets at least two times a week in their cooperative groups and they spend at least 25% of the class period in these groups.
b. The groups consist of 2-4 students in which the group arrangement allows everyone to see and hear all other members of the group.
c. The students are aware of group process skills, but do not usually use them and/or are not promoted by the teacher.
d. The students are homogeneously grouped by ability.
e. Social group skills are not promoted.
f. The teacher usually does not interact with cooperative groups and acts as a facilitator only at times.
g. Some of the groups in the class are interdependent and others are not.
h. Some individuals are off task consistently during the class period.
i. Activities are centered around the cooperative learning groups.

No Cooperative Learning Environment:

a. The class meets once a week or less or not at all in cooperative groups.
b. When groups are formed in the classroom, they consist of 2 or more students and the group arrangement varies.
c. Group process skills are not promoted.
d. Social skills are not promoted.
e. The teacher acts as an information giver. Student-student interaction is minimal.
f. Class activities are centered around lecture, note taking, teacher demonstrations, and verification type labs.

DEPENDENT VARIABLES: **PERCEPTIONS OF THE SCIENCE CLASSROOM ENVIRONMENT - 5 SCALES**

COHESIVENESS

SATISFACTION

DIFFICULTY

COMPETITIVENESS

FRICTION

For the quantitative component, the My Class Inventory (MCI), developed by Fraser et. al. (1982) was used to assess the perceptions of classroom environment. This instrument consisted of five scales: cohesiveness, friction, difficulty, satisfaction, and competitiveness. The five scales are explained below in further detail:

Satisfaction: extent of enjoyment in class work.

Friction: amount of tension and quarrelling.

Competitiveness: emphasis on students competing with each other.

Difficulty: extent students find difficulty with class work.

Cohesiveness: extent students know, help, and are friendly toward each other.

A pretest and posttest were given to all classroom groups. The pretest was administered during the first two weeks of the 1991-92 school year to all treatment and control groups. Each group was given the posttest twenty five weeks later to assess change in their perceptions of the science classroom environment.

Reliability and Validity of the MCI

There are 38 items on the MCI. According to Fraser and Fisher (1981), the alpha reliability for each scale using the student as the unit of analysis is as follows: Cohesiveness (.67), Friction (.67), Difficulty (.62), Satisfaction (.78), Competitiveness (.71). The internal consistency reliability for each scale using the classroom as the unit of analysis is as follows: Cohesiveness (.80), Friction (.75), Difficulty (.73), Satisfaction (.88), and Competitiveness (.81). The scale intercorrelations were calculated using the class mean as the unit of analysis. The intercorrelation for the MCI scales range from -.41 to .05. The mean intercorrelations for each scale is as follows: Cohesiveness (.27), Friction (.30), Difficulty (.20), Satisfaction (.28), and Competitiveness (.13). The mean intercorrelation is .23 (Fraser, Anderson, & Walberg, 1982). According to Fraser (1992), the method of interpreting the scores is not based on an absolute scale. Based on the computed subsection score, the higher the score, the stronger the perception of that particular dimension.

Cooperative Learning Assessment Instrument (CLAI)

Qualitative data were collected to supplement and explain the quantitative data. For the qualitative component, the researcher observed cooperative learning classrooms environments. Data were collected and recorded to obtain an accurate picture of the characteristics of each type of learning environment. In addition, the researcher developed an instrument to assess the quality and quantity of cooperative learning in the science classroom based on a literature review, instruments developed by Van De Ven (1976), Thompson (1967), BSCS (1989), and Johnson (1991).

To assure that the questionnaire was identifying and measuring what the researcher intended, the questionnaire was given to an expert panel to examine for face validity and they were also asked to match the above measures to the questions to see if they could identify to what measure the question was directed. The instrument was also given to two teachers who were familiar with cooperative learning to check for readability and understanding. The teachers who were involved with the research study were given the questionnaire. Then the researcher observed each of the teachers' classrooms on several occasions and then checked her observations with the teachers' responses to the questionnaire to see if the two agreed to what was actually happening in the classroom. These observations indicated the instruments were measuring the desired cooperative learning components.

Study Population and Sample

This study was conducted at two schools in the suburbs of a Midwestern city. The school district

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covers twenty five square miles. The student populations were 1020 and 540, respectively. The middle schools were made up of sixth through eighth grades. Fifteen teachers and 1185 students participated in the research study. Participation in the study was strictly voluntary, but all students and teachers agreed to participate.

Demographically speaking, the school populations consist of lower middle to middle income families. The ethnic population is made up of the following groups: eighty eight percent (88%) are white, ten percent (10%) are black, and two percent (2%) are Hispanic, Asian, or other. The average daily attendance of the students at the schools is ninety four percent (94%). Ninety seven (97%) of the students are transported to the school by bus.

Description and Comparison of Experimental and Control Group Programs

The following is an overview of the classrooms which were studied in this investigation. At one of the middle schools, a new science curriculum, Science and Technology: Investigating Human Dimensions (BSCS, 1991), was in its second year of being field tested by BSCS. In order to implement the field test program as smoothly as possible, workshops were conducted periodically for the teachers. These workshops covered topics such as cooperative learning, specific activities, and assessment. The teachers who were at this field test school had extensive cooperative learning workshops to help them implement this teaching method in their science classrooms. During the first year of the field testing, the teachers had a half day workshop on theory and practice of cooperative learning and throughout the first year they had numerous meetings to discuss problems and solutions they were experiencing and the researcher visited the schools every week to aid the teachers. Prior to the second year of field testing, the science teachers had a one day workshop on cooperative learning. With one full year of experience using cooperative learning techniques in their classrooms and being exposed to the workshops and discussions, the teachers were prepared to use these techniques for the second year in science. They had obtained the skills to properly structure and organize their classrooms to incorporate the necessary components of cooperative group learning and to solve and/or avoid problems.

Due to different teachers' philosophies and personalities, the quality and quantity of cooperative learning varied. The purpose of the teacher questionnaire and observations was to group the science classrooms based on the quality and quantity of cooperative learning. The quality of cooperative learning was based on the measures of time spent in cooperative groups, group processing skills, social skills, and group arrangement.

The other middle school involved in the study used a traditional science curriculum. The sixth grade science curriculum is based on Silver Burdett's (1985) general science, text program. The seventh and eighth grades higher ability group of students used Merrill's (1985) earth and physical science program

respectively. The lower ability group of seventh and eighth graders used Heath's (1985) earth and physical science. The format of the science class at this school was lecture, note taking and traditional lab investigations. The students worked in groups during the lab activities. At least one of the teachers had had some cooperative learning experience and used this teaching technique sporadically. The other four teachers at the school were aware of cooperative learning but did not use it in their classrooms.

To minimize the variance due to curricula differences, classrooms from both schools were categorized according to the level of cooperative learning environments. Based on the results of the teacher questionnaire and the observations, all science classrooms in both schools were assigned to one of the three groups: high cooperative learning science environments, average cooperative learning science environments, or no cooperative learning science environments. The no cooperative learning science classrooms acted as the control groups and the high and medium cooperative learning science classrooms were the treatment groups.

Data Analysis - Statistical

A 3 x 3 factorial multivariate analysis of covariance design was used to analyze the data obtained from the MCI instrument. The first factor was the type of learning approach, and consisted of (1) high cooperative learning environment, (2) average cooperative learning environment, and (3) no cooperative learning environment. The second factor was ability level of the learner and consisted of (1) high ability (2) average ability (3) low ability. The perception dimensions measured were cohesiveness, satisfaction, difficulty, competitiveness, and friction. The pretest results were used as the covariates and the posttest results were used as the dependent variables. The factorial multivariate analysis of covariance analysis as discussed by Stevens (1986) was employed to determine whether there were any main effects or interactions. A Tukey post hoc procedure was used to determine where the significant results lie. The SPSSX statistical package was used for analyzing all data.

Classroom subgroups were used as the unit of analysis. The individual perception scores were combined to find the average of the environment scores of all students within the same class. Then within each class, the students were further divided into ability groups. These classroom subgroups were used as the unit of analysis. The ability levels were determined by accessing students' Student Ability Index (SAI) scores which is a score computed from the Otis-Lennon School Ability Test. The cutoff score were as follows: a) low ability - SAI score less than 96 b) average ability - SAI score greater than or equal to 96 to a score less than or equal to 117 c)high ability - SAI score greater than 117.

CELL GROUP SIZE MATRIX
Table 1

COUNT	NO COOPERATIVE ENVIRONMENT	AVERAGE COOPERATIVE ENVIRONMENT	HIGH COOPERATIVE ENVIRONMENT	ROW TOTAL
LOW ABILITY	19	16	15	50
AVERAGE ABILITY	22	20	20	62
HIGH ABILITY	13	12	15	40
COLUMN TOTAL	54	48	50	152

Note: Classroom subgroup as the unit of analysis

Qualitative Data Analysis

The qualitative data which were collected consisted of classroom observations and informal interviews with teachers. The purpose of the qualitative component was to verify the type of cooperative learning environment and to describe the particular events occurring in those types of classrooms. Fifteen classroom observations were made during the third week of February and the first week of March. The teacher interviews took place during the month of January and February. At least five observations were made of each type of environment: the no cooperative learning environment, the average cooperative learning environment, and the high cooperative learning environment. A description and comparison of the three types of cooperative learning environments are presented in this section.

No Cooperative Science Learning Environment

Various activities that occurred during the observations of these types of classrooms were lecture, note taking, laboratory investigations, teacher demonstrations and answering written questions. Two examples of no cooperative science learning environment observations are given.

Example 1

During one of the observations, the student activities concentrated on answering questions that were given to them as homework the night before and then answering more questions that were in their textbooks. The teacher asked the questions and the majority of the students participated in answering the questions. When the class had trouble answering a particular question, such as the definition of half life, the teacher proceeded in explaining the concept to the class. The students interacted with the teacher and not with each other. After the students completed their assignments, they talked quietly among themselves. Several concepts which were taught were methods of estimating the age of the earth, half life, and geologic column.

According to the teacher who taught this class, the course of study and methodology used followed the book very closely. This format included verification labs, answering questions from the book and discussion of readings. No cooperative learning took place. During investigations, the students worked in groups but the groups were not structured to incorporate positive interdependence, shared leadership, or the promotion of social skills.

Example 2

Another teacher who was observed had his students conduct a lab investigation. The students sat in groups of four at one table. The teacher had written the investigation procedure on the board and students copied it down in their notebooks. The teacher then passed out the equipment and read the first direction and then allowed the students to do that step. After each step, the teacher asked questions concerning the observations the students had made. This process continued until the experiment was completed. Any questions the students had were directed at the teacher and most interactions between students pertained to whose turn it was to do that particular step. At the end of the experiment, the teacher asked questions about what they had observed and had the students draw some conclusions. He then ended the class with a demonstration. The instructional methods used by this teacher during the observed lesson were teacher-led discussions, a demonstration, and a student activity which was directed by the teacher who gave very specific procedural instructions.

Several principle components characterized the no cooperative learning science environments. The majority of the class period was spent on whole class or individual oriented type activities. The classroom interactions were primarily between the teacher and students. Rarely were there student-student interactions. If there was this latter type of interaction, it was off-task type behaviors or questions pertaining to the directions of the investigation. During lab investigations, students worked in groups that were characterized by one student as leader, questions directed to the teacher rather than the lab partners, and each individual completing the assignment related to the lab rather than a group assignment.

Average Cooperative Learning Science Environment

The average cooperative science learning environment combined characteristics of high cooperative learning environments and no cooperative learning environments. Two examples of observations are given.

Example 1

After a brief introduction and review by the teacher, the students broke into their cooperative learning groups. The activity was to solve several mysteries using evidence and inferences from the given stories. The groups were to try and solve the mysteries together and then report their results to the rest of the class. Each student was assigned a particular job to do for the group. There were individuals who did not follow their job assignment. For example, a student who was not the communicator asked the teacher a question. The teacher did not reinforce that only the communicator could ask him a question. Some of the groups were involved in solving the mysteries, while other individuals within groups and even entire groups were off task and socializing. These individuals listened for the answers from other groups or students. In other groups, the students were discussing the mysteries and developing arguments to explain the mysteries. After the small group discussion, the class reconvened and the groups presented their results. Some groups did an excellent job, while others were disorganized and found it difficult to answer the teacher's questions. After this class observation, the teacher commented on the lack of cooperation within certain groups. He believed that part of the problem was due to homogeneous ability grouping. Some of the groups were all low ability students.

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Example 2

In another observation of a science classroom classified as a average cooperative learning environment, the teacher started the lesson by reminding the students the class's goals for the week. The students' job for the day was to have the cooperative groups prepare for an oral presentation on the research project that they have been working on together. Each student in the group was to participate in the presentation in some way. The researcher observed a couple of groups who worked diligently and discussed ways they wanted to present the information. Students within these groups were working on posters, looking up information in reference books, and writing down the manner in which the research would be presented. Other groups were off task the entire class period. The teacher repeatedly had to visit these tables and offer suggestions, make reprimands, or attempt to help the group problem solve. As soon as the teacher left, these students returned to activities such as socializing, working on homework, or just doing nothing.

In an interview with this particular teacher, she expressed her frustration with working with this particular class. She stated,

> I constantly have to remind these students to stay on task. They tend to discuss very little among themselves. It's hard to determine exactly what the groups are accomplishing. Out of this entire class, only about six students have produced anything.

The researcher noted several characteristics of the average cooperative classroom which included: activities that were cooperative learning oriented and involved critical thinking, students worked in groups of 2-4, role assignments given to each student within that group although not always followed, approximately half the groups off task and the other groups doing the appropriate group work, interactions with the teacher were frequent and interactions between students in some groups were productive and in other groups it was not, and groups were made up of low and average ability students. Some groups were off task the majority of the class period. No promotion of social group skills was evident in the observations.

High Cooperative Learning Science Environment

The high cooperative learning classrooms were observed and the following are examples of those classrooms.

Example 1

As soon as the bell rang, the teacher told the class that they would be working in teams of two for the day's activity. The students were asked to turn to a certain text book page. The students were asked to decide who would be the tracker and who would be the communicator for the activity. The teacher moved quickly around the room to check on their role assignment decisions. The teacher then spoke to the whole class and had the students focus on the social skill of the activity which was praising. He asked for someone to describe what the social skills would sound like and look like to an observer. The students responded eagerly.

Next, the teacher provided some suggestions on how the groups might structure their work. The

students worked together very well to achieve the goals for the day. The only person who spoke to the teacher was the communicator and the groups discussed the points and problems concerning the activity. The teacher walked around the room and interacted with the groups or just listened to what they were discussing. As the students worked, the teacher often reminded them about the other components of cooperative learning by asking such questions or making comments such as: "are you the communicator? o.k. you can talk to me then." or he approached a group and asked "Is Amy doing a good job?" The group replied "yeah". The teacher said "well. tell her!" When the groups completed their assignment, the teacher reconvened the whole class and they discussed their results.

Example 2

Another high cooperative learning environment classroom, the cooperative learning groups were in the idea generating stage of designing a toy with certain constraints and criteria. The teacher reminded the groups of the social skill they were to practice. As the students worked in their groups, the observer noticed that the students agreed or disagreed nicely with other students as ideas were generated. One of the constraints for the toy design was a certain allotment of money to buy materials. During the discussion phase, the teacher walked around the room and monitored the groups. She gave the groups positive feedback and told them they were doing well. One group of two girls and a boy were having problems on deciding the toy design. The teacher asked the group to come up with some solutions so that they could work together better. The teacher also gave her impression of how she thought the group was working together. One of the suggestions by a group member was to eliminate all the ideas they had generated and come up with totally new ideas. The group agreed to do this and the discussion proceeded. Each group devised a plan for a design the toy and the class ended.

The characteristics of a high cooperative learning environment based on the observations were high interaction between students and cooperative learning based activities. The groups often monitored their own behavior. For example, one student in the high cooperative classroom was working on his homework and not doing the group task. Another group member said to him, "hey, why are you doing your homework in this class? You're supposed to be helping me. You can write this down." The student then began to write what he was supposed to be writing. The students practiced using social group skills and the teachers in these learning environments interacted, listened, acted as facilitator and monitored groups closely.

According to Fraser (1992), the method of interpreting the scores is not based on an absolute scale. Based on the computed subsection score, the higher the score, the stronger the perception of that particular dimension. For example, a student who has a score of twenty on the competitiveness perception perceives the classroom as a much more competitive learning environment that a student who scores a 12. There is no cutoff point of perceptions of low competitive environment, neutral competitive environment, or high competitive environment.

The student data was aggregated by type of cooperative learning environment and ability level. There were 64 classrooms which were divided into the high cooperative learning environments, average cooperative learning environments, and no cooperative learning environments. Classrooms were further

divided by ability levels into classroom subgroups. The total number of classroom subgroups was 152. The data was aggregated to find the group mean on each dependent variable and thus the classroom subgroups were used as the unit of analysis. In the table below, the breakdown of the groups is given.

Limitations and Validity Issues

The researcher acknowledges the limitations of this study. In order to control for the influences of the curricula differences, the researcher equated the classrooms as much as possible on the cooperative learning environment type. In addition, a separate 2 x 3 multivariate analysis of covariance was conducted which eliminated the school with the no cooperative learning classrooms. The researcher attempted to control for differences by administering the teacher questionnaire and made classroom observations to equate the classrooms in each cooperative learning category as much as possible. Components, other than the five measured by the My Class Inventory, were not measured and could be confounding variables to the study. The cooperative learning teacher questionnaire was developed by the researcher and has not been used before to evaluate the type of cooperative learning environment.

The nonequivalent control group design (Campbell and Stanley, 1963) controls for most threats to internal validity, including history, maturation, testing, instrumentation, and mortality.

RESULTS AND DISCUSSION

Conclusions of Factorial MANCOVA

Using the classroom subgroups as the unit of analysis, the significant results of the 3 x 3 factorial multivariate statistical analysis were the main effect of type of cooperative learning environment and ability level. Further univariate analysis showed that the dimensions of cohesiveness and competitiveness were significant for the cooperative learning environment and cohesiveness was significant for ability level. There were no interaction effects between the factors of cooperative environment type and ability level.

A Tukey post hoc procedure was conducted to discover what groups were associated with the significant dimensions. For the cohesiveness variable, the results indicated that low ability students perceive the science environment as more cohesive than their average ability peers, and high ability students perceive their science learning environment as the least cohesive of the three ability levels.

Cohesiveness was also a significant dimension for the type of cooperative learning environment. The no cooperative learning environment classrooms perceive their classrooms as more cohesive than the average and high cooperative learning environments. There was no significant difference between the high cooperative and average cooperative learning environments on this dimension. Another dimension which was significant for the type of cooperative learning environment was competitiveness. The Tukey procedure indicated the no cooperative learning environment groups view their classrooms as more competitive than the average cooperative environments and the average cooperative environment perceives themselves as less competitive than their high cooperative environment cohorts. No significant difference was found between

the no cooperative and the high cooperative environments on the dimension of competitiveness.

The univariate results indicated that the dimensions of satisfaction, friction, and difficulty were not significant for the type of cooperative learning environment. In addition, the dimensions of satisfaction, friction, difficulty, and competitiveness were not significant for ability level.

Ability Main Effect Results
All Classroom Subgroups
Table 2

EFFECT ..ABILITY

Multivariate Test of Significance (S=2, M=1, N=66)

1Test	Value	Approx.F	Hypoth DF	Error DF	Sig of F
Pillais	.22	3.31	10.00	270.00	.000*
Wilks	.79	3.38	10.00	268.00	.000*

Note: Classroom subgroup as unit of analysis
*p<.05

Univariate Results for Ability
All Classroom Subgroups
Table 3

EFFECT..ABILITY

Univariate F-Tests with (2,138) D.F.

Var	Hypoth SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
DIF	22.82	669.57	11.41	4.85	2.35	.099
COH	34.11	384.84	17.06	2.79	6.12	.003*
COM	15.48	440.26	7.74	3.19	2.43	.092
SAT	20.93	1194.23	10.46	8.65	1.21	.302
FRI	5.27	524.12	2.63	3.80	.69	.502

Note: Classroom subgroup as unit of analysis
*p<.05

Main Effect of Types of Cooperative Environments
All Classroom Subgroups
Table 4

EFFECT..COOPERATION

Test	Value	Approx.F	Hypoth. DF	ErrorDF	Sig of F
Pillais	.21	3.14	10.00	270.00	.001*
Wilks	.80	3.17	10.00	268.00	.001*

Note: Classroom subgroup as unit of analysis
*p<.05

Univariate Analysis on Cooperative Environments
All Classroom Subgroups
Table 5

EFFECT...COOPERATION
Univariate F-tests with (2,138) D.F.

Var.	Hypoth SS	Error SS	Hypoth. MS	Error MS	F	Sig. of F
DIF	18.23	669.58	9.22	4.85	1.90	.154
COH	23.33	384.84	11.67	2.79	4.18	.017*
COM	38.89	440.26	19.44	3.19	6.10	.003*
SAT	32.75	1194.23	16.38	8.65	1.89	.155
FRIC	9.37	524.12	4.69	3.80	1.23	.294

Note: Classroom subgroup as unit of analysis
*p<.05

Ability Level & Cohesiveness

The first dimension addressed is cohesiveness which refers to how students perceive themselves as part of a group. The fact that the low ability groups perceive the science classroom as a more cohesive environment than their peers of average and high abilities with high ability students' perceptions being the least cohesive is interesting. Previous research shows that high ability students are often viewed as the 'nerds' or 'eggheads' of the class and are ostracized (Johnson, et.al., 1984). These data support this notion. Since high ability students tend to be more academically oriented, they focus on the subject, rather than other students. At the middle school level, these students may feel even more alienated as peer groups form which are based more on social than on academic terms.

In terms of the high cohesiveness perceived by the low ability students, there may be two reasons for this result. Low ability students who may not have the opportunity to talk with their peers about academic material may find science the only time they discuss subject matter with their peers. Due to the nature of the science classroom, more chances to interact in laboratories and hands on activities may be available. Group work may be rewarded more and the low ability students receive some type of positive feedback for academic achievement as opposed to a classroom where all the work is done individually and academic success is not routine.

The qualitative data gathered from the teachers suggested that the low ability students, who often come from low socioeconomic homes, stick together more because the group "is their family." One teacher stated "low ability students lack the confidence (of academic ability) and so they stick together." The teachers explained high ability students perceptions of less cohesiveness were due to the students "high confidence in themselves, they don't need anybody" (academically).

Cooperative Learning Environment and Cohesiveness

Cohesiveness with the type of cooperative learning environment was significant also. No cooperative environment members perceive their classrooms as being more cohesive than the average and high cooperative environment classrooms. One would expect the average and high cooperative environments make people feel like they are more part of a group and this study provides evidence that it does not. How much of an impact the field testing of a new curriculum has on the average and high cooperative environment science rooms must be taken into consideration. Due to the fact the students are part of this major change in how science is taught and what is being taught, may produce a classroom environment which is viewed at times, as chaotic, unstructured, and disjointed. The students in the no cooperative environment groups are being taught in the manner that they always have been. The way they perceive the cohesiveness of the environment has probably not changed. But in the average and high cooperative learning environments, students are placed in peer groups with individuals with which they have not interacted. For middle school students to leave the comfort of their usual friends and work in this type of environment may result in perceptions of lower cohesiveness. Just being placed in unfamiliar groups may make then feel this way. Additionally, these students may be still going through a change process which can be very chaotic (Fullan, 1982).

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Cooperative Learning Environment and Competitiveness

The results also disclose no cooperative learning groups perceive the environment as more competitive than the average cooperative groups. This evidence is supported by research previously conducted where cooperative learning enhances cooperation rather than competition (Slavin, 1990). For example, in the observation of one no cooperative learning classroom, the students worked individually on textbook questions and the interaction which took place was between the student and teacher. Even when the students are asked to work together on labs or other hands on activities, they often work do not work as a team. In another cooperative classroom where the students were in groups of four doing an experiment, the only characteristic of a team was that they were sitting at the same table. Student questions were directed at the teacher, not at one of their lab partners. The only interactions between students dealt with who got to do what next!

A surprising result is the significant difference which shows that high cooperative learning environments perceive more competitiveness than the average cooperative environment. According to previous research one would expect the opposite. The answer to this paradox lies within the qualitative data. Students who work within the high cooperative learning environments interact face-to-face a great deal with one another. They work very closely with their peers and discuss topics thoroughly. For example, students who were working on solving mysteries in a high cooperative learning environment argued and went over the evidence and inferences from the reading very analytically. They wrote down their groups' ideas and each group presented results.

With the same activity, in the average cooperative learning environment, the free rider effect took place. This is described by Kerr and Bruun (1983) as letting one or two members of the group do the task while the less able members give less effort. Little effort was put forth by some of the group members, but there appeared to be little concern for this occurrence by the other students. To the researcher, the average environment was much more unstructured and an 'I don't care attitude' was pervasive. The teachers of the average cooperative groups called these students "the floaters". "They're (the average cooperative students) just floating. They're not real academic oriented and they don't quite fit in with the low level kids, so they just hang out."

This atmosphere contrasted sharply with the high cooperative environment where individuals within the group placed pressure on the lackadaisical students to interact and perform. One of the observation of a high cooperative learning classroom a girl in the group asks a boy 'why are you doing your homework? You're supposed to be helping me! You write it down.' The boy put away his work and did as he was told. In another group, a girl in the group says she'll write down what needs to be written because 'you write so sloppy'. Students in these high cooperative groups appear to be under more peer pressure to perform certain tasks than the average cooperative groups. In the high cooperative classrooms, the students have to give their opinions, and ideas. To middle school students who value their peers' opinions, it may create personal turmoil to express their thoughts. The way middle school students view this pressure and interaction creates a perception of more competitiveness. This increased perception of competitiveness

supports an exploratory study conducted by Wang and Walberg (1986) which suggested that programs which might be expected to promote cooperation and reduce friction, could actually increase students sensitivity to differences in ability and their perceptions of competitiveness.

The results of the data provide evidence that the perceptions of cohesiveness and competitiveness change when ability level and the type of cooperative learning environment changes. The perception of difficulty, satisfaction, and friction were not significantly different on the two factors.

Secondary Analysis

One might argue that the results found in the 3 x 3 Factorial Mancova are due to variance from the two different schools involved; schools which have different science curricula, principals, physical conditions and different ways of impacting students overall. In order to test the validity of this argument, a 2 x 3 Factorial Mancova was performed which eliminated the no cooperative learning environment classrooms. All of these classrooms were located in one of the schools and the average and high cooperative environment classrooms were at the other school. Thus this analysis eliminates all variance due to having two different study sites. Again, the unit of analysis is the classroom and includes 98 classrooms: 48 average and 50 high cooperative environment classrooms.

Ability Level and Cohesiveness

For the ability level factor, the dimension of cohesiveness had similar results as the previous analysis. The low ability groups perceived their science learning environments as more cohesive than the high ability groups. There was no significance on the average ability students and cohesiveness.

Cooperative Learning Environment and Cohesiveness

Cohesiveness with type of cooperative learning environment which was significant in the first analysis was not significant in this analysis which eliminated the no cooperative groups. Why? If one recalls, the first analysis showed there was a significance between the no and the average cooperative learning environments and between the no and the high cooperative learning environments. There was no significance between the average and high cooperative learning environments. In both cases the no cooperative learning groups viewed the environment as a more cohesive place. When the no cooperative groups were deleted, no significance would surface. In other words, average and high cooperative classrooms do not view their classroom differently on the dimension of cohesiveness.

Cooperative Learning Environment and Competitiveness

Competitiveness with the type of cooperative learning environment was significant with the high cooperative learning environment classrooms viewing their environment more competitively than the average cooperative learning environments. This is the same result as the previous analysis and yields further support to the notion that high cooperative learning classroom interactions are more demanding than the average cooperative learning classrooms.

Cooperative Learning Environment and Satisfaction

Ability by Cooperative Mancova
No Coop Grps Eliminated
Table 6

EFFECT.... ABILITY BY COOPERATION
Multivariate Tests of Significance (S=2, M=1, N=40.5)

Test Name	Value	Approx. F	Hypoth DF	Error DF	Sig of F
Pillais	.21	1.99	10.00	168.00	.037*
Wilks	.80	1.97	10.00	166.00	.039*

Note: Classroom subgroup as unit of analysis.
*p<.05

Main Effect Results of Cooperative Environment Types
No Coop Grps Eliminated
Table 7

EFFECT... COOPERATIVE ENVIRONMENT
Multivariate Tests of Significance (S=1, M=1.5, N=40.5)

TestName	Value	Exact F	Hypoth DF	Error DF	Sig. of F
Pillais	.16	3.26	5.00	83.00	.010*
Wilks	.83	3.26	5.00	83.00	.010*

Note: Classroom subgroup as unit of analysis.
*p<.05

Main Effect of Ability Levels
No Coop Grps Eliminated
Table 8

EFFECT... ABILITY
Multivariate Tests of Significance (s=2, M=1, N=40.5)

Test Name	Value	Approx F	Hypoth DF	Error DF	Sig of F
Pillais	.23	2.18	10.00	168.00	.021*
Wilks	.77	2.26	10.00	166.00	.017*

Note: Classroom subgroup as unit of analysis.
*p<.05

Univariate Tests for Ability
Classroom Subgroup as Unit of Analysis
Table 9

EFFECT.. ABILITY
Univariate F-tests with (2,87) D.F.

Variab.	HypotSS	ErrorSS	HypotMS	ErrorMS	F	Sig F
DIFF.	4.56	372.76	2.28	4.28	.53	.589
COHES.	13.55	202.17	6.78	2.32	2.92	.059*
COMPET.	12.55	308.30	6.27	3.54	1.77	.176
SATIS.	26.80	729.97	13.40	8.39	1.60	.208
FRIC.	3.99	328.67	1.99	3.78	.53	.591

Note: Classroom subgroup as unit of analysis.
*p<.05

Satisfaction, a dimension which was not significant in the analysis including all three types of cooperative learning environments, was significant for this analysis indicating that high cooperative learning environment members are more satisfied than their average cooperative learning environment cohorts. One reason why this dimension was probably not significant in the previous analysis could be attributed to the no cooperative groups results varying from being very satisfied to less satisfied, thus overshadowing any significance which was present. Working in cooperative groups is something middle school students enjoy tremendously and this is reflected in the high satisfaction scores. The fact that satisfaction is high in cooperative learning groups is supported by research which indicates the middle school students find peer relationships as a critical element in their development and socialization (Hartup, Glazer, & Charleworth, 1976). The high cooperative learning groups work better together than the average cooperative learning groups which resulted in an increased level of satisfaction.

The difference in the satisfaction perceptions between the average and high cooperative learning environments can also be attributed to the quality of interactions that occur in the high cooperative setting versus the average cooperative ones. In one high cooperative learning classroom, the groups were allotted a certain amount of play money to buy materials for a toy they were designing. In a group of three, the boy told his team mate that the wheel she wanted to buy is too small for the toy. He explained to her why it wouldn't work. She asked him questions "well, what if we put the wheel on like this?' and "but if we buy the larger wheel, we won't have enough money for the other stuff." This type of interaction is opposed to an average cooperative interactions where some of the group members were doing nothing, doing homework, socializing, or working on the activity.

Unlike the 3 x 3 analysis, the 2 x 3 multivariate analysis provided evidence of a significant interaction between the two factors: type of cooperative learning environments and ability level. The univariate test did not reveal any one dimension to which this significance can be credited. Distinguishing between the dimensions and their contributions to the overall multivariate significance is difficult. In order to make any conclusive remarks, further research needs to be conducted on the dimensions and the use of a more sensitive instrument would be needed to help decipher this interaction.

Discussion

Knowledge of the perceptions of science students in different types of cooperative learning environments provides a foundation for orchestrating changes in the classroom environment that will most benefit students. In this study, several components emerged that were significant; cohesiveness and competitiveness. When examining the research study, considerations about the conclusions must be made. These points are discussed below.

The fact that the BSCS middle school curriculum was in its second year of field testing has to be considered in these results. To what extent this effect had on this study cannot be determined. According to Fullan (1982), it takes at least two years for a complete change to occur and Johnson and Johnson say one year is needed in order to for teachers to adequately incorporate cooperative learning into their

classrooms. Since the field testing was in its second year, these teachers should be able to adequately use cooperative learning. Other confounding factors which could not be controlled were the school environments and different teachers. Based on the qualitative and secondary quantitative data, similar results were obtained. However, how the school is administered, the physical conditions of the facility, and the general everyday atmosphere may have an effect on the students' perceptions.

Another issue of concern when reviewing the study's results is the cognitive and affective development of middle school students which ranges widely from student to student. It is not uncommon to hear middle school teachers make comments about their students acting like adults one minute and little children the next. This inconsistent behavior is expected due to the fact that many middle school students are in the transitional stage of cognitive development. This stage means students are in between the stages of concrete and formal operational thinking patterns (Piaget, 1964). As Fraser (in press) stated measures of the environment "involve judgments of psychological or social-psychological states of classes or schools". Considering perceptions are related to the psychosocial level, it is not surprising to find a wide variance of perceptions.

Considering all analyses and results, it is reasonable to believe that cooperative learning does influence student perceptions of the science classroom environment. Several factors relevant to this study in how the type of cooperative learning environment established in the science classroom and the varying affects on students' perceptions of the learning environment are addressed. The quality of the cooperative learning is a major determiner in how students perceive the science classroom. How cooperative learning functions within a classroom is dependent on the teachers and the students. When science teachers implement cooperative learning into their classrooms, they assume that their students will receive all the benefits that cooperative learning has promoted. According to this study, this is not the case.

The teachers involved in this study were trained in the same workshops on how to use cooperative learning, but how they implemented it in their classroom varied a great deal. The BSCS curriculum was written to incorporate cooperative learning within the specific science activities, yet the cooperative learning varied from teacher to teacher, classroom to classroom. This study and Meichtry's (1991) research support the notion that regardless of the workshops, curriculum materials, and outside support, the teachers to a large extent determine the success of an implementation of a teaching strategy. Teachers who did not explicitly reinforce rules related to cooperative learning tended to have classrooms which were categorized as average cooperative learning. The connections to the activity and how cooperative learning works were often left up to the students to make and in many classrooms the students did <u>not</u> make these connections which resulted in a less than desirable cooperative learning environment.

Based on the qualitative data, the perceptions of who one's students are influences teachers. A teacher who may have a high cooperative learning classroom environment during one period, may have an average cooperative learning classroom in another period. Why? During informal interviews, many teachers expressed that "this class is all low ability kids, cooperative learning just doesn't work." Whether the teachers have these perceptions of their students inability to work in cooperative groups predetermines the

effectiveness of the cooperative learning or whether it really cannot work in this type of classroom cannot be completely answered from this study. The qualitative data did suggest that the average cooperative learning environments consisted of low and average ability students, whereas the high cooperative learning environments were made up of average and high ability students. One of the prerequisites for cooperative learning groups is the formation of heterogeneous groups. The observed groups were mixed heterogeneously by race and gender, but ability was often homogeneously grouped.

The research study demonstrates that distinct cooperative learning environment affects students' perceptions differently. Perceptions of cohesiveness and competitiveness of the classroom environment are significantly affected by the cooperative learning environment. Awareness of the impact of these components on the classroom environment can help teachers create a climate which is most suitable for their students. Depending on the quality of the cooperative learning, the strategy can have a positive or negative effect on students' perceptions of the science learning environment. It appears that explicit skills must be expressed to the students, connections of specific behaviors to cooperative learning must be stated, and heterogeneous grouping by ability is necessary for high cooperative learning environments to be established.

Recommendations for Future Research

In order to extend the findings of the perceptions of the cooperative learning environment, studies which analyze the variance between ethnic groups, socioeconomic groups, gender, urban, rural, and suburban schools, and grade levels are essential. The impact that different teachers and their perceptions of their students have when using cooperative learning could aid in understanding why cooperative learning works better for one teacher than it does for another. A more sensitive instrument could assess the strength of the perceptions of the cooperative learning environment. Using the cooperative learning group as a unit of analysis may provide a more accurate way of assessing the perceptions of these students. A comparison between homogenous group and heterogeneous groups' perceptions could assist in clarifying the qualitative data related to teachers perceptions of the inability of low ability students to perform in cooperative learning groups.

In relation to the many science reforms taking place in our schools, science programs are undergoing complicated, in-depth changes and assessing how the changes affect the learning environment perceptions could provide information for improving the change process. Research-based knowledge about different components of innovative curriculum such as the BSCS middle school project can be used to measure its impact on students' perceptions of the learning environment. Longitudinal studies which include how perceptions of the learning environment change along with these reforms could provide valuable information for facilitating change. A focus on teacher perceptions of the cooperative learning science classroom as opposed to their students' perceptions would aid teachers in improving and changing the environment to benefit their students.

The value of interpretive studies cannot be undermined. With this type of data, one can begin to identify key components of the classroom that are related to student perceptions. Interviewing students or

shadowing a cooperative learning group would provide insight to student perceptions of this type of learning environment. The qualitative data obtained in this study provided tremendous amount of information to interpret the quantitative results. A research study which focussed only on collecting qualitative data would be beneficial to the knowledge base. People involved in the science reform have supported the use of cooperative groups, working in collaboration with others to imitate how scientists work, now it is up to the researchers to discover if this teaching methodology is doing what we think it is.

Conclusion

When cooperative learning is established in a classroom, many teachers would believe that all cooperative classrooms are similar and have the same impact on students' perceptions. What has been revealed in this study is the quality of cooperative learning creates a particular type of learning environment which results in different student perceptions. Additionally, the ability level of students results in different perceptions of the science learning environment.

Considering all the recommendations to use cooperative learning in the science classroom, awareness of the type of learning environment which is constructed must be weighed. Questions which we must ask ourselves are: How effective is the cooperative learning environment? Do our students view the classroom as I do? What can I do to enhance their perceptions? Is this type of learning environment beneficial for learning science?

If cooperative learning is advocated for the science classroom, we must assure ourselves that this strategy is accomplishing what we want. The perceptions of the cooperative learning environment provide a small but vital piece of information in determining the appropriateness of this methodology. Further research in this area is necessary to study the effects of the cooperative learning environment and its influence on student perceptions of the science classroom environment.

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COOPERATIVE LEARNING TEACHER QUESTIONNAIRE

The following questionnaire is concerned with how your students work in cooperative learning groups. Several processes that characterize cooperative learning groups are: students use face-to-face interaction, students learn to use **interpersonal** and **small group skills**, individuals are **accountable** for their work, yet they need to work **interdependently** with other group members to accomplish the task successfully. Cooperation and collaboration are stressed rather than competition in the groups.

- Think about how your students work in groups.
- If you think all your classes work similarly, fill out one questionnaire.
- If different classes work differently in groups, please fill out a questionnaire for each one of those classes.
- Please make sure you indicate what class period you are describing.
- Remember these questions refer to any classroom situation where the students are working in groups.

TEACHER NAME _____

CLASS PERIOD(S) _____

1. How many days of an average school week do you use cooperative learning groups? (Check only one.)

_____ Once a week or less (such as every other week).

_____ 2 - 3 times a week

_____ More than three times a week.

_____ I use other strategies and techniques that are different from cooperative learning groups.

IF YOU DO NOT USE COOPERATIVE LEARNING GROUPS IN YOUR CLASSROOM, DO NOT ANSWER THE REMAINING QUESTIONS.

2. What group size do you use most often in your classroom? (Check only one.)

_____ Two or three students per group

_____ Four or five students per group

_____ More than five students per group

3. How do you arrange your classroom? (Check all that apply.)

_____ Students within the group sit in an arrangement so that each student can see and hear all other group members.

_____ The different groups are physically separated so that they do not interfere with each other's learning and I can easily move from group to group.

_____ The different groups sit where and in whatever arrangement they want.

_____ The different groups are not physically separated, but are in an arrangement so that each student can see and hear all other group members.

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4. For the average group activity, how do you distribute materials to group members? (Check only one.)

_____ Every student within the group receives the same set of materials.

_____ Every student within the group shares one set of materials.

5. When the students are in their cooperative groups, approximately what percent of the class period is spent on cooperative learning group activities? (Check only one.)

_____ 0 - 25% of the class period.
_____ 25 - 50% of the class period.
_____ 50 - 75% of the class period.
_____ more than 75% of the class period.

6. Within their groups, how do most of your student cooperative learning groups reach consensus on the answer to a problem or the answer to a question? (Check only one.)

_____ Students make no attempt to reach a consensus.

_____ A few students dominate the group and their points of view are accepted without challenge.

_____ Most of the students argue their points of view and change their minds only on the basis of the data.

7. How do you promote the mastery of interpersonal and group skills by your students? (Check all that apply.)

_____ I rarely have time to focus on social skills.

_____ I usually tell the students the social skills they need to use, but rarely have time to see if the students are using the skills.

_____ Usually I explain the social skill that we are focusing on, demonstrate or model the skill, observe the groups, and provide feedback on how well they are utilizing the skill.

_____ I have students evaluate their own use of social skills.

8. Who monitors the group activities in your classrooms? (Check all that apply.)

_____ There is no formal observation of group functioning.

_____ I monitor the groups and share feedback with the students.

_____ The students monitor their own groups and provide feedback for each other.

_____ One student from each group is assigned the task of the monitoring the group's activities and gives feedback to them.

9. How do your students work within their cooperative learning groups? (Check only one.)

_____ Most of the time students work individually within their groups without talking to other members.
_____ Most of the time students compete with the other group members.

_____ Students within a group share ideas and materials so that most of the members are involved.

_____ Students within a group share ideas and materials making sure that all group members are actively involved.

10. What method do you use to set up a group goal? (Check only one.)

_____ I don't use a group goal; each student works individually to achieve the goal of the lesson.

_____ I have each student complete the goal individually and then have them discuss their method, results, etc... with other members of the group.

_____ I have all students within the group work together to achieve the goal.

_____ I have some students working individually and some students working with other members to achieve the goal.

11. Student-student interaction (check only one)

_____ students usually listen to one another's viewpoints and questions.

_____ students usually do not listen to one another's viewpoints and questions.

12. Student openness (Check only one.)

_____ students usually respect one another's viewpoints and questions.

_____ students do not usually respect one another's viewpoints and questions.

13. For the most part, when groups are formed (check only one.)

_____ students decide who will be members of their group.

_____ the teacher assigns students to groups.

14. The make up of these groups (check all that apply)

_____ are mixed by gender.

_____ are mixed by ability.

_____ are mixed by race.

_____ are homogeneous (all the same).

15. The relationship within groups is (check one)

_____mainly competitive.

_____mainly cooperative.

_____neither competitive or cooperative.

16. The relationship between groups is (check one)

_____mainly competitive.

_____mainly cooperative.

_____neither competitive or cooperative.

17. Estimate the percentage of groups in a classroom in which one or more students are not part of the group process (examples are one student doing all the work while others watch, one or more students consistently off task, or a lack of respect for the input of one or more students.)

_____%

18. Students seek help (check only one)

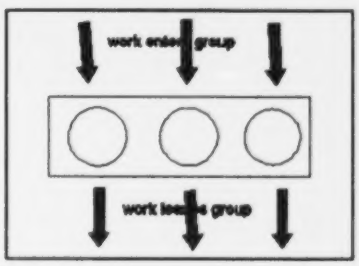
_____ mainly from other students

_____ mainly from the teacher

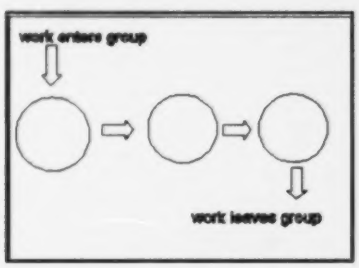
_____ They do not seek help from anyone.

19. The following diagrams show alternative ways work is accomplished in a group. Read each description and then circle the letter by the diagram which best describes how most of the groups in your classroom perform their job tasks. Each circle represents a student in the group. The number of students in the group is arbitrary.

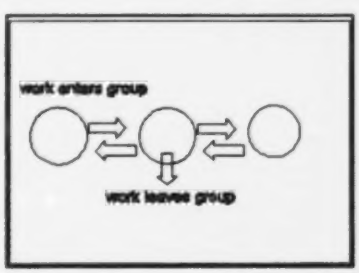
Case 1 - Work and activities are performed by individuals and there is little interaction between them.



Case 2 - Work and activities are performed by individuals but there is interaction in only one direction.



Case 3 -Work and activities are performed by the individuals who interact in only one direction or reciprocally communicate between individuals in the group.



Case 4 - Work and activities are performed by the diagnosis, problem-solving and collaboration of group members. Interaction is among all group members.